UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/550,805	07/12/2006	Tominaga Koji	FUJ0001US	3990

23413 7590 08/24/2010

CANTOR COLBURN, LLP
20 Church Street
22nd Floor
Hartford, CT 06103

EXAMINER	
LUKE, DANIEL M	
ART UNIT	**PAPER NUMBER**
2813	

NOTIFICATION DATE	DELIVERY MODE
08/24/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

usptopatentmail@cantorcolburn.com

Office Action Summary	Application No.	Applicant(s)	
	10/550,805	KOJI ET AL.	
	Examiner	Art Unit	
	DANIEL LUKE	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 June 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 13-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 13-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/14/2010*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the amendment filed 6/21/2010.

Currently, claims 1-9 and 13-21 are pending.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 5/14/2010 was filed after the mailing date of the non final office action on 1/21/2010. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 8, and 13-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paranjpe et al. (US 2003/0003635).

Pertaining to claim 1, Paranjpe shows a method of forming an insulating film in a semiconductor device, the method comprising: sequentially repeating a plurality of times: forming a partial insulating film ([0031]), and removing impurities from the partial insulating film ([0034]; [0011], lines 8-9).

With regards to the thickness of each partial insulating film, although Paranjpe discloses that the anneal is performed when the partial insulating film is at a thickness of 25-50 Å ([0009], line 15), Paranjpe also discloses that the anneal is performed every 25 to 50 ALD cycles at 0.8 Å per cycle ([0009], lines 16-17). 25 cycles at 0.8 Å per cycle equates to a thickness of 20 Å, or 2 nm, which coincides with the upper limit of the claimed range. Thus, Paranjpe suggests that the anneal may be performed when the partial insulating film has the claimed thickness of 2 nm.

In addition, throughout the reference, Paranjpe discloses performing an anneal every 25 to 50 cycles. Since Paranjpe discloses that the thickness of each partial insulating film is 0.8 Å per cycle, one of ordinary skill in the art would arrive at the claimed invention by performing an anneal after the minimal number of cycles disclosed by Paranjpe (see [0012], lines 15).

With regards to the temperature of the removing impurities step, Paranjpe discloses that the step may be performed at an elevated temperature ([0034], lines 9-13). Although Paranjpe does not disclose that this temperature is greater than 500°C, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Paranjpe by using a temperature greater than 500°C, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

And finally, although Paranjpe does not explicitly show that residual carbon is amongst the impurities removed, one of ordinary skill in the art recognizes that since the precursor comprises carbon and the final film is over 99% pure Al_2O_3, carbon must have been amongst the impurities removed.

As it pertains to claim 8, and as previously discussed, Paranjpe allows for a partial insulating film thickness of 2 nm.

As it pertains to claims 13 and 14, although not explicitly shown by Paranjpe, one of ordinary skill in the art recognizes that the annealing processes of Paranjpe will cause desorption of different carbon-containing compounds, including CO_2.

Pertaining to claims 15 and 16, Paranjpe shows forming the partial insulating film comprises depositing trimethyl aluminum ([0030], lines 3-6).

Pertaining to claim 17, Paranjpe shows that water vapor is used as an oxidant for the precursor ([0031], lines 1-6).

Claims 2-7, 9, and 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paranjpe in view of Colombo et al. (US 2005/0136690).

Paranjpe teaches the method of claim 1.

Pertaining to claim 9, Paranjpe shows a method of forming an insulating film in a semiconductor device, the method comprising: sequentially repeating a plurality of times: forming a partial insulating film ([0031]), and removing impurities from the partial insulating film ([0034]; [0011], lines 8-9).

Pertaining to claim 21, Paranjpe shows a method of forming an insulating film in a semiconductor device, the method comprising: sequentially repeating a plurality of times: forming a partial insulating film by atomic layer deposition employing an Al precursor, an Hf precursor, or a combination comprising at least one of the foregoing precursors ([0030], lines 1-

6), while employing water vapor gas as oxidant ([0031], lines 1-6); and removing impurities from the partial insulating film ([0034]; [0011], lines 8-9).

Although Paranjpe does not explicitly show the thickness of the partial insulating film or the temperature at which removing impurities is performed, or that the impurity removed comprises residual carbon, these limitations are either suggested by Paranjpe or are obvious, as indicated in the rejection of claim 1 above.

Paranjpe fails to show, pertaining to claim 2, removing impurities is performed in a reducing gas atmosphere; and, pertaining to claims 3, 9 and 21, that removing impurities comprises a first treatment in a reducing gas atmosphere and a second treatment in an oxidizing gas atmosphere. Pertaining to claims 4-7 and 18, Paranjpe fails to show the possible gases that make up the reducing and oxidizing gas atmospheres.

However, Colombo teaches in [0013] – [0014] that a high-k dielectric film is subjected to two anneals, both at temperatures in the range of 500°C to 1100°C. The first anneal is performed in a reducing gas atmosphere ([0013], lines 1-4). The reducing gas atmosphere may comprise, for example, hydrogen ([0013], lines 7-8). The second anneal is performed in an oxidizing gas atmosphere ([0014], lines 1-4). The oxidizing gas atmosphere may comprise, for example, oxygen. These anneals act to remove impurities from the dielectric film ([0011]), specifically carbon that is a result of using a metalorganic precursor ([0010], lines 5-8).

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to perform the step of removing impurities in the method of Paranjpe by a two-step anneal process in which the first anneal is performed in a reducing gas atmosphere and the second anneal is performed in an oxidizing gas atmosphere, as taught by Colombo. The

motivation to do so is that the anneal process taught by Colombo reduces point defects and impurities in the dielectric film ([0005]).

As it pertains to claims 19 and 20, Paranjpe shows that the method is repeated until a desired thickness is achieved ([0031], lines 22-23). Although Paranjpe does not show that the method is repeated three or eight times, as claimed, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Paranjpe by repeating the method the claimed number of times, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Response to Arguments

Applicant argues that one of ordinary skill in the art would not find it obvious to use a temperature greater than 500°C in the removing impurities step in the invention of Paranjpe because Paranjpe teaches away from the claimed temperature range. Applicant cites paragraphs [0009], [0031] and [0051] as examples that Paranjpe teaches a generally low temperature, specifically between 60 and 350°C, and thus teaches away from the claimed temperature range.

In each of paragraphs [0009], [0031] and [0051], Paranjpe teaches a relatively low temperature *for the deposition step* (emphasis added). The deposition step is a completely different step that precedes the removing impurities step. Thus, the cited paragraphs do not teach away from using a temperature greater than 500°C in the removing impurities step in the invention of Paranjpe.

Further, Paranjpe allows for "elevated temperatures" in some embodiments for the removing impurities step, as discussed in paragraph [0034], lines 9-13. Again, although

Paranjpe does not disclose that this "elevated" temperature is greater than 500°C, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the invention of Paranjpe by using a temperature greater than 500°C, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL LUKE whose telephone number is (571)270-1569. The examiner can normally be reached on Monday through Friday 8:30 a.m. to 5:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Landau can be reached on (571) 272-1731. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. L./
Examiner, Art Unit 2813
8/17/2010

/Matthew C. Landau/
Supervisory Patent Examiner, Art Unit 2813